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4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction and Compliance

This section forms the scientific and analytic basis for the comparisons under Sections 1502 and 1508 of NEPA. It consolidates the discussions of those elements required by Sections 102(2)(C)(i), (iv), and (v) of NEPA, which are within the scope of the Environmental Impact Statement (EIS), and as much of Section 102(2)(C)(iii) as is necessary to support the comparisons. This section also includes those sections defined in the SEPA rules under WAC 197-11-440, part 6.

The discussion includes a discussion of the environmental impacts and benefits of the programmatic alternatives.

Since this is a programmatic analysis, the direct and indirect impacts of the alternative are discussed first, followed by the cumulative impacts analysis. The subsequent NEPA/SEPA environmental review will include a project-specific impact evaluation for each of the proposed restoration projects identified in the attached Restoration Plan (Volume II of this document).

Section 5 discusses the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources.

4.2 Definition of Direct, Indirect and Cumulative Impacts

As defined by the Council on Environmental Quality's NEPA regulations applicable to all federal agencies, 40 CFR Part 1508:

"Direct impacts" are caused by any action and occur at the same time and place.

"Indirect impacts" are caused by actions that are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems, including ecosystems.

"Cumulative impact" is the impact on the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

"Effects" and "impacts" are used synonymously in the CEQ regulations. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historical, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions

which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

4.3 Overview of Alternatives

The following discussion considers potential environmental consequences resulting from any of the alternatives that involve proposed restoration activities. As described in detail in Section 2, three major alternatives have been identified for evaluation in this programmatic EIS: No Action, the multi-species approach, and the chinook salmon species approach (the chinook salmon was recently listed as a threatened species).

- *Alternative 1 - No Action* involves various agencies continuing to implement their individual restoration programs, but not under the umbrella program that would occur under the action alternatives.

- *Alternative 2 – Multi-Species Approach (Preferred Alternative)* would result in an agency-coordinated, concerted effort to implement restoration programs that would simultaneously maximize the benefits to multiple fish and wildlife species.

- *Alternative 3 – Single-Species Restoration (Chinook Salmon)* would result in an agency-coordinated, concerted effort to implement restoration programs that would benefit the recently listed chinook salmon, even if they did not benefit other species.

Three subalternatives have been identified for the multi-species and single-species approaches:

- The *Ecosystem/Habitat Forming Method* (Subalternatives 2A and 3A) includes developing restoration projects that replicate natural processes with minimum future maintenance.

- The *Engineered Design and Constructed Habitat Method* (Subalternatives 2B and 3B) includes implementing engineered projects.

- The *Integrated Method* (Subalternatives 2C and 3C) provides for an integrated approach that would include a combination of natural processes and engineered projects.

Given that this evaluation is programmatic, further descriptions including those regarding erosion control and mitigation procedures found in the Restoration Plan (Volume II) will be discussed later in the project-specific environmental documents.

4.4 Geological Resources

The primary intent of restoration activities for the Duwamish and Green River system is to change the existing channel and bank characteristics to be representative of more natural conditions. Soils and stream morphology, both dynamic conditions in riverine systems, would be modified along the Green River as a result of these changes. These modifications would occur for all alternatives including No Action.

4.4.1 Geology and Soils

Under all alternatives (Alternatives 1, 2A, 2B, 2C, 3A, 3B, 3C) including No Action, short-term impacts to soils would occur during the construction phase, and to a far lesser extent over the long term from implementation of the restoration features.

Construction impacts would result from the movement and use of construction equipment at the restoration sites. The level of impact would vary from site to site depending on location, current level of disturbance, soil types, presence of hard-surfaced roads (access), and other factors. Construction activities would result in localized and temporary disturbance to soils at the construction sites, soil compaction, and removal or modification of coarse channel deposits and/or finer overbank alluvium. This material would either be repositioned on the restoration site or taken offsite for disposal.

4.4.1.1 Removal and/or Redistribution of Bank and Channel Alluvium

Restoration activities for all alternatives (1, 2, 2A, 3A, and 3B) would result in beneficial changes in the geomorphic characteristics and distribution of alluvium throughout the Green River system. Under Alternative 1 (No Action), beneficial changes would be more isolated and limited to small areas of tributaries and the mainstem, whereas under Alternative 2, the beneficial impacts would be more far-reaching, including larger areas of tributaries and the mainstem of the river.

Under Alternative 3, the beneficial impacts would be similar to those in Alternative 2, but with the focus being on mainstem of the river, the principal habitat for chinook salmon.

The long-term impacts to soils would be associated with the ongoing function of the restoration activities. Since the Green/Duwamish River system is dynamic, the movement of alluvium exposed to river flows will continue over the long term. The restorations would result in conditions in portions of the river that would mimic more natural movement of channel alluvium and gravels than under existing conditions. The sedimentation processes will be incrementally improved over time by restoring predisturbance hydrologic regimes that facilitate natural sediment movement and sediment storage, and reducing bank erosion, thus decreasing sediment loads into aquatic systems.

4.4.1.2 Modification to Channel Depth and Profile

Modifications to channel depth and profile will occur under all alternatives (Alternatives 1, 2A, 2C, 3A, and 3C) except 2B and 3B (engineered subalternatives). These changes would result from such restoration activities as removing and/or relocating levees, importing sediment (gravels, cobbles), improving channel cross-sections, and importing large woody debris (LWD). Profiles and channel depth would be modified initially during the construction phase, but these changes would result in a long-term beneficial modification to depth and profile conditions designed to benefit the fish resources in the basin.

Alternative 1 (No Action) would result in project-by-project localized and isolated improvements in channel profile where gravel and LWD are added in tributaries and the mainstem. Under Alternatives 2A and 2C, the beneficial changes in channel profile and depth would also occur in

tributaries and in the mainstem, but at more locations and a greater area (square footage) than under No Action. Under Alternatives 3A and 3C, channel profile and depth changes would be concentrated in the mainstem of the Green River to benefit chinook salmon.

4.4.1.3 Stabilization of Banks and Reduced Erosion

Under all alternatives, the planting of streamside vegetation on river and stream banks would result in improved bank stability and reduced erosion of fine sediments. There would be no adverse impacts to soils associated with planting streamside vegetation.

4.4.2 Hazardous Materials

There is general concern that some project sites in the industrial portions of the Duwamish may have potentially contaminated soils. This concern diminishes as one moves up the basin and away from possible contamination sources.

There is a potential for encountering hazardous materials at restoration sites, particularly in the lower basin. The potential for hazardous waste will be evaluated on a project-by-project basis. Land use practices at each restoration site will be examined to determine if there is a reason to believe that potential contamination exists. If the determination is made that there is a contamination potential, then the proper sampling intensity will be conducted to determine the type and extent of contaminants. Where appropriate, soil testing will occur and all applicable regulations shall be followed. If testing indicates that there are contaminants at the site, the site will be cleaned up in compliance with pertinent regulations. If the contamination is too severe, the project will be abandoned.

4.4.3 Stream Morphology

Impacts on stream morphology would be long term rather than construction-related. Main and side channel modifications, installation of in-channel structures (e.g., LWD), and importing gravel all represent activities that, in the long term, are designed to beneficially alter the morphology of the Green and Duwamish Rivers. These stream modifications are directed toward restoring the long-term function of aquatic and riparian ecosystems. Channel modifications or installation of habitat features in the channel would alter flow velocities, width/depth ratios, and floodplain connectivity, and increase in-stream structural complexity and diversity. Ultimately such fish habitat characteristics as substrate embeddedness, pool frequency and quality, and off-channel habitat will improve as a result of the changes in stream morphology.

4.5 Water Resources

The restoration alternatives will modify surface and groundwater conditions and improve conditions for salmonid and riparian resources. These modifications would apply to all alternatives including No Action.

4.5.1 Surface Water

All proposed restoration alternatives, including No Action, will to some degree affect surface water conditions within the Green River Basin. During construction, short-term modifications to

surface water patterns (rerouting) would be required during installation of restoration features such as reconnecting channels, removing culverts, and installing woody debris. Such modifications would routinely be accomplished using established construction procedures such as temporarily installing half or full culverts to carry surface flows around active construction areas.

The implementation of most proposed restoration activities would permanently modify existing surface water conditions. Patterns of surface water movement would be changed by removing or reducing barriers to fish passage, importing gravel and LWD, modifying channel profiles (Alternatives 1, 2A, 3A), constructing artificial features, or removing existing in-stream structures (Alternatives 2B, 2C, 3B, 3C). The minor increases in streamside vegetation (Alternatives 1, 2A, 2C, 3A, 3C) along tributaries and the mainstem from revegetation activities would not result in seasonal modifications in surface water, however such increases in vegetation would result in localized modifications in evaporation and transpiration along the river, more closely emulating historic conditions.

Most of the proposed restoration activities would involve construction within the floodplain. Changes in water elevations associated with the restoration activities would be evaluated on a project-specific basis to ensure that changes meet the requirements of the Federal Emergency Management Agency (FEMA) and King County ordinances. A separate section entitled "Floodplain Finding" as required by Executive Order 11988, "Floodplain Management," will be incorporated by reference into the final, project specific environmental document (such as project specific Environmental Assessment). Flooding and floodplain assessments will be done on a site by site basis and will require site specific information and analysis. Any adverse impacts to floodplains are anticipated to be minor because careful planning and mitigation for adverse impacts would be part of any of the restoration efforts.

4.5.2 **Groundwater**

Restoration activities such as reconnecting old channels and removing or relocating levees would result in localized recharging to groundwater wherever surface water patterns are modified, such as at spring locations. This would result in a benefit to localized hydrology, resulting in a system that more closely emulates historic conditions.

4.6 Water Quality

Short-term impacts to water quality would occur during construction from the movement and use of construction equipment at the restoration sites, and from the excavation or addition of gravels and other soils. The level of impact would vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced roads (access), and other factors. Drainage and grading/erosion control plans would need to be prepared for each specific project proposed. In general, it can be anticipated that, even with erosion control, under Alternatives 1, 2A, and 2C, some sediments would move off construction sites into tributaries, and some sediments would move into the mainstem under Alternatives 1, 2A, 2C, 3A, and 3C. When considered within the context of all the other activities in the basin that continue to affect Green River water quality, the small scale and short duration of potential restoration activities would result in insignificant effects to this resource.

In the lower river (Duwamish Estuary), construction-related impacts to water quality associated with habitat improvements (e.g., creating deltaic habitat) under Alternatives 1, 2A, and 2C are expected to be within the range of natural seasonal variability of turbidity. The river currently meets Ecology's water quality standards for turbidity according to the Section 303(d) list. Turbidity within the Turning Basin ranges from 2.0 to 122 nephelometric turbidity units (NTUs) (with a mean of 29 NTUs), and varies with depth and tidal stage (Muckleshoot Indian Tribe Fisheries Department unpub.).

Under all alternatives, water quality would improve in the long term as the function of the restoration projects increases, particularly for those activities designed to increase streamside vegetation and bank stability. Streamside planting and protection of riparian zones (Alternatives 1, 2A, 2C, 3A, and 3C) would further provide filtration of overland (particularly sheet flow) surface water movement and water quality protection, as well as improvements to stream temperatures due to increased shading.

Under Alternatives 2B and 3B, construction-related (short-term) water quality impacts as described above would be associated with such engineered restoration activities as the construction of hatcheries, incubation ponds, and artificial spawning channels. Long-term water quality impacts, particularly those associated with hatcheries, would need to be addressed in subsequent NEPA environmental review for each specific project.

4.7 Fisheries

Restoration activities covered under this programmatic EIS would occur within salmonid migration, spawning, and rearing habitat within the Green/Duwamish River system (Water Resource Inventory Area 9). The overall purpose of the restoration plan is to improve the health of the Green/Duwamish River ecosystem for fish and wildlife by restoring the amount and quality of spawning and rearing habitat as well as water quality.

4.7.1 Fish Habitat

The focus of the project alternatives will be to enhance fish habitat in the upper, middle, and lower basins. Alternatives 1 (No Action) and 2 (A, B, and C) would provide restorations for the wide variety of salmonids utilizing the river system.

During the construction phase, proposed restoration activities will temporarily cause increases in the amount of fine (primarily suspended) sediment in the water column. This would occur primarily during modifications to the streambed and physical placement of habitat improvements such as LWD, rock, and gravel. Adverse changes in water temperature would not occur since, with a few exceptions, existing vegetation will be left onsite during construction.

The likelihood of any increased turbidity from the construction/implementation of the restoration activities affecting salmonids is relatively minor for several reasons. First, the activities would be implemented during the prescribed in-water work windows when the potential for these species occurring in the Green River Basin would be minimal. Second, construction activities would be isolated from surface waters using construction phasing, using sediment Best Management Practices (BMPs), and minimizing the duration and extent of in-water work. Third,

any turbidity increases associated with the implementation of activities would be localized and short term (generally hours). And lastly, salmonids are tolerant of short-term exposures to high suspended sediment concentrations (Cordone and Kelly 1961; Servizi 1992; Martin et al. 1976, Reading et al. 1987). Under Alternative 1 (No Action), beneficial changes to fish habitat would be more isolated and limited to small areas of tributaries and the mainstem, whereas under Alternative 2, the beneficial impacts would be more far-reaching, including larger areas of tributaries and the mainstem of the river.

Under Alternatives 3A and 3C (single-species restoration, chinook salmon), restoration projects would focus on habitat improvements within the mainstem of the Green River, the principal use area for that species. Such activities would include creation of deep pools and installation of large cobble substrate (1-inch to 6-inch range) within the mainstem.

In the long term, activities such as importing sediment and LWD, improving channel cross-sections, and planting vegetation along tributaries and the mainstem would aid in modifying the in-stream habitat (pool-riffle ratio, pool quality index) in the middle and lower basins, as well as the retention time and nutrient transformation of salmon carcasses in the river.

Under Alternatives 2B and 3B, activities such as reducing impervious surfaces and constructing artificial habitat features would improve salmonid habitat, while construction of such projects as artificial spawning channels and incubation ponds would be designed to improve salmonid production.

4.7.2 Fish Use

Over 30 species of fish have been documented within the Green/Duwamish River, eight of which are salmonids. These include chinook (summer and fall); coho; chum; rainbow/steelhead (summer and winter); resident and sea-run cutthroat; and lake and mountain whitefish. The status of a ninth species, bull trout, is unknown based on the 1998 Washington Salmonid Stock Inventory appendix (WDFW 1998). Field studies to characterize population/run size status are lacking. No studies confirm reproduction of bull trout/Dolly Varden in the Green River Basin, and there is no confirmation or quantitative measure of bull trout/Dolly Varden natural production or juvenile rearing in the Green River. Pink and sockeye salmon have been observed in low numbers in the mainstem Green River and Soos Creek (Goetz pers. comm.). The source of these fish (natives or strays) is not known. No stocks of these species have been identified for the Green River (Hard et al. 1996, Gustafson et al. 1997).

During construction of in-water improvements (e.g., culvert rehabilitation, flap gate repair), short-term blockages to fish passage would likely occur due to stream diversion. Impacts would be minor since the in-water work would be limited to that time period when the potential for upstream-migration of adults or downstream-migration of juveniles would be minimal (i.e., the in-water work window will be defined as a condition in the Hydraulic Project Approval issued by the Washington Department of Fish and Wildlife).

In the long term, the proposed restoration activities in Alternatives 2A and 2C would improve fish habitat with the purpose of increasing use by the wide variety of fish species in the tributaries and mainstem, but with a focus on improving habitat for salmonids. Restoration

projected in the estuary (e.g., creating deltaic habitat, restoring wetlands) would also benefit estuarine intertidal fish species (see Section 3.5 for a description of fish species found in the estuary).

Restoration activities such as removing barriers, modifying channel profiles, adding gravel and LWD, and creating habitat structures provide recognized benefits to salmonids (Washington Department of Fish and Wildlife 1998; USFWS unpub.; Spence et al. 1996). The level of benefit to be achieved through implementation of these activities will be based on such site-specific factors as location, existing riparian vegetation, proximity to other habitat, stream channel profile, velocity, and a variety of other factors.

Implementation of Alternatives 3A and 3C would result in similar benefits, but with a focus on mainstem chinook habitat improvements. The installation of LWD, deep pools, and large cobble substrate would provide new or improved mainstem habitat for chinook salmon, while creating side channels, relocating levees, and planting streamside vegetation would provide additional rearing habitat.

Alternatives 2B and 3B would focus on restorations/improvements with engineered solutions such as the construction of artificial habitat structures, artificial spawning channels, and incubation ponds. Some of these activities would result in modification of existing engineered elements of the basin to benefit either a variety of fish species (Alternative 2B) or chinook salmon (Alternative 3B). This could include the integration of fish habitat features into flood protection structures (e.g., levees, riprap, dams, bridges and roads, etc.). Habitat improvements would follow guidance such as the "Integrated Streambank Protection Guidelines" (WDFW 1998) and techniques defined by the U.S. Fish and Wildlife Service (USFWS) (unpub.).

Alternative 2C and 3C would represent an integration of the natural and engineered alternatives. Impacts/benefits of these alternatives would be similar to Alternative 2A.

4.7.3 Aquatic Invertebrates

One of the benefits associated with the implementation all alternatives (Alternatives 1, 2A, 2B, 2C, 3A, 3B, 3C) would be that of providing additional habitat for aquatic invertebrates. The restoration activities likely to represent the greatest benefits would be importing sediment and LWD, creating deltaic habitat in the estuary, planting streamside vegetation, and constructing habitat features. These activities would serve to increase habitat complexity, improve primary productivity through plantings and increase aquatic invertebrate diversity, abundance, and distribution.

The installation of large cobble substrate (up to 6 inches in diameter) under Alternatives 3A and 3C would provide a stable substrate environment for aquatic insects in the mainstem of the river.

4.7.4 Threatened, Endangered, and Candidate Fish Species

All proposed alternatives and restoration activities would occur within the range and known occurrence of the following threatened, endangered or candidate fish species:

- Chinook salmon (*Oncorhynchus tshawytscha*) - Listed threatened in Puget Sound

- Bull trout (*Salvelinus confluentus*) - Listed threatened in Coastal/Puget Sound population
- Coho salmon (*Oncorhynchus kisutch*) - Candidate in Puget Sound

Letters from the USFWS, National Marine Fisheries Service (NMFS), WDFW, and Washington Department of Natural Resources are included in Appendix C of this document. As a requirement of the Endangered Species Act, programmatic Biological Assessments (BAs) have been prepared for the preferred alternative and the 50 proposed projects of this restoration plan. The BAs follow the USFWS and NMFS assessment guidelines for effect determinations at the basin scale.

As a general rule, and based on existing resource information, the existing environmental conditions of the Green River Basin can be considered as "Not Properly Functioning" as salmonid habitat. This applies to the following pathways and indicators:

- Water Quality - Temperature, sediment, chemical contamination
- Habitat Access - Physical barriers
- Habitat Elements - Substrate, LWD, pool frequency, pool quality, off-channel habitat, refugia
- Channel Conditions - Width/depth ratio, streambank condition, floodplain connectivity
- Flow/hydrology - Peak and base flow, drainage network
- Basin Conditions - Road density and location, disturbance history, riparian reserves

Portions of the Green River, the Duwamish River Estuary, and several tributaries to the Green River are water quality impaired according to the Washington State Department of Ecology's Section 303(d) list. The impairments include fecal coliforms, metals, temperature, dissolved oxygen, and hydrocarbons.

All project alternatives (Alternatives 1, 2A, 2B, 2C, 3A, 3B, 3C) would result in short-term impacts associated with transport of sediment to surface waters during the construction/site stabilization process. Sediment input to surface waters can cause localized turbidity and increase sediment deposition to the streambed during construction

Potential direct effects to chinook salmon, coho salmon, or bull trout would include:

- Sediment pulses from bed and bank disturbances have the potential to affect fish that are using the project area. However, construction will occur only during the approved in-water work windows, thereby minimizing any potential risks. Construction BMPs will also be used to minimize the potential for sediment transport. Any increases in turbidity would be localized and short term. Also, salmonids are relatively tolerant to short-term turbidity pulses. See more detailed discussion under Sections 4.7.1 - Fish Habitat and 4.7.2 - Fish Use.

- Hazardous materials associated with the proposed project will be limited to those substances associated with construction equipment, such as gasoline and diesel fuels, engine oil, and hydraulic fluids. An accidental spill of these substances could contaminate drainages, soils, wetlands, and other environmentally sensitive areas. However, the spill prevention and control plan will not allow any storage of materials or maintenance of equipment or fueling within 100 feet of the channel edge.

- Dredging has the potential to affect fish that are using the project area. However, construction will occur during the approved in-water work windows, thereby minimizing any potential risk

- Increase in habitat will occur by connecting side channels and floodplains, reconstructing channels, restoring wetlands and estuaries, and adding in-stream structure (LWD and gravel).

In the long term, the proposed alternatives and restoration activities would either maintain or improve the quality of conditions for the listed species.

4.8 Botanical Resources

4.8.1 Vegetation

The proposed alternatives and restoration activities would require limited modifications to existing vegetation during construction, and, in the long term, would improve riparian and wetland resources in the middle and lower basins. Vegetation changes under Alternatives 1 (No Action), 2A, 2C, 3A, and 3C would occur primarily in riparian or wetland areas adjacent to the Green/Duwamish River and tributaries.

4.8.2 Wetlands and Riparian Areas

Impacts to wetlands under Alternatives 1 (No Action), 2A, 2B, 2C, 3A, 3B,and 3C would depend on the location and type of restoration activity. Activities could affect wetlands in two ways: during construction of restoration projects, and as an element of the restoration (i.e., restoration and connection of wetlands to the river). Subsequent NEPA environmental review would be completed for all proposed projects, and would include (1) identification and delineation (if needed) of wetlands in construction access road corridors, construction staging areas, and at project sites, (2) description of any impacts to wetlands, (3) evaluation of alternatives to avoid impacts to wetlands, (4) identification of practicable methods and measures to minimize impacts to wetlands, and (5) mitigation of any unavoidable impacts

One of the activities under Alternatives 2A and 2C would involve excavating material from wetlands to ensure that elevations are achieved to connect the wetlands to the river. This would involve using heavy equipment to remove soil material from the wetland. Such activities would cause short-term impacts to wetland resources, but in the long term, the proposed restorations would return many of the historic natural functions of the wetlands (e.g., hydrologic connection to river, improved habitat for fish and wildlife).

Short-term impacts to riparian resources would occur during the construction phase of restoration activities. Depending on the type of restoration and location, vegetation may need to be removed for equipment to gain access to the restoration sites. This could result in the temporary reduction of woody vegetation (shrubs and trees) along stream and river banks. Other vegetation also may need to be removed to gain access from existing roads to the restoration sites

In the long term, riparian vegetation would increase as a result of streamside planting. The species, location, and density of vegetation for planting would vary based on site-specific conditions. The species of choice would be those defined as preferred for riparian planting by King County, the Corps, WDFW, USFWS, and the Natural Resources Conservation Service (NRCS).

4.8.3 Threatened, Endangered, and Candidate Plant Species

According to the USFWS (Appendix C), one federally listed endangered species, the marsh sandwort (*Arenaria paludicola*), could potentially but is unlikely to occur within wetlands near areas proposed for restorations.

There are no known recorded locations for this species, and according to the Washington Department of Natural Resources Natural Heritage Information System, the species is possibly extirpated from the area (see Appendix C).

In addition to the federally listed threatened and endangered species, Appendix C also includes State of Washington-listed endangered, threatened and sensitive vascular plants. As a part of the site-specific environmental process for restoration projects, each site will be surveyed for sensitive species to determine presence and to ensure that the proposed projects do not adversely impact sensitive plants.

4.9 Wildlife

Restoration activities covered under this programmatic EIS would occur within wildlife habitat in the Green/Duwamish River system (Water Resource Inventory Area 9). The overall purpose of the restoration plan is to improve the health of the Green/Duwamish River ecosystem for fish and wildlife by restoring habitat. As a result, all project alternatives will have some short-term construction-related impacts on wildlife, but will ultimately result in improved habitat conditions for a variety of wildlife.

4.9.1 Wildlife Habitat and Use

The focus of the project alternatives will be to improve fish and wildlife habitat in the middle and lower basins. As a part of the program to improve fish habitat, Alternatives 1 and 2 (A and C) would also improve wildlife habitat throughout the river system.

During the construction phase, proposed restoration activities will temporarily impact wildlife habitat elements. These impacts will include noise from equipment and removal of vegetation to gain access to the restoration sites. Construction may also temporarily affect water quality due to disturbance to in-stream and riparian areas.

In the long term, restoration activities, particularly as a part of Alternatives 1, 2A, 2C, 3A, and 3C, would result in an improvement to wildlife habitat. The activities of greatest benefit to wildlife would include importing and placing gravel and LWD, planting vegetation along tributaries and mainstem, increasing floodplain habitat and wetlands, and protecting floodplain and wetland habitat.

Activities such as constructing the artificial habitat feature component of Alternatives 2B, 3B, and the engineered habitat of Alternatives 2C and 3C would result in more limited benefit to wildlife than would occur under Alternatives 2A and 3A (Ecosystem/Habitat-Forming Method). These improvements would provide more localized primary and secondary productivity at the project sites. The proposed restoration activities in Alternatives 2A and 2C would improve wildlife habitat with the purpose of increasing use by a wide variety of species in the tributaries and mainstem, but with a focus on improving habitat for salmonids. Improvements to support salmonids would result an increase in the distribution and abundance of fish that would in turn benefit wildlife dependent on or associated with salmon. Restorations to the estuary (e.g., creating deltaic habitat, restoring wetlands) would also benefit a variety of estuarine-dependent wildlife, specifically waterfowl and shorebirds.

4.9.2 Threatened, Endangered, and Candidate Species

All proposed alternatives and restoration activities would occur within the range and known occurrence of the following threatened, endangered or candidate wildlife species:

- Bald eagle (*Haliaeetus leucocephalus*), threatened - There are 15 bald eagle nesting territories and one communal roost throughout the Green River Basin (upper, middle, and lower basins). Wintering bald eagles occur along much of the river from October 31 through March 31.

- Gray wolf (*Canis lupus*), endangered – If it does occur, the wolf would be only in the upper basin above Howard Hanson Dam.

- Canada lynx (*Lynx canadensis*), threatened – May occur in the upper basin but there is no documentation.

- Marbled murrelet (*Bracyyramphus marmoratus*), threatened – Marbled murrelets were found on 1,100 acres of U.S. Forest Service land in the upper Green River Basin during 1999. Nesting occurs from April 1 through September 15.

- Northern spotted owl (*Strix occidentalis marmoratus*), threatened – Known to occur only in the upper basin on U.S. Forest Service land. There is a lack of suitable habitat elsewhere in the basin. Nesting activities occur from March 1 through September 30.

- Oregon spotted frog (*Rana pretiosa*), candidate - This candidate species may occur in the basin.

- Mardon skipper (*Polites mardon*), candidate – This candidate species may occur in grassland habitat in the basin.

- Peregrine falcon (*Falco peregrinus*) - officially de-listed August 25, 1999 and no longer subject to Section 7.

Letters from the USFWS and WDFW are included in Appendix C of this document. As a requirement of the Endangered Species Act, a programmatic Biological Assessment (BA) has been prepared for the preferred alternative of this restoration plan. The BA follows the USFWS assessment guidelines for effect determinations on listed wildlife.

The only threatened and endangered species known to occur in the vicinity of future restoration projects is the bald eagle, which commonly occurs in the basin. While currently a listed threatened species, the USFWS has given notice on a proposed rule to delist the species (Federal Register July 6, 1999 [64 FR 36454]). There are no known nests or critical habitat at the 50 proposed project sites. Site-specific analyses would be conducted at each of the project sites prior to commencement of the projects to ensure that no unknown nests occur that could be affected by construction.

For the gray wolf and Canada lynx, the only potential habitat for these wide-ranging species occurs in the upper Green River Basin and for the lynx, areas above 4,000 feet in elevation. None of the alternatives would adversely affect either of these species since none of the alternatives would remove suitable habitat. The only potential habitat for marbled murrelets also occurs in the upper basin. None of these birds were observed during surveys conducted by the Washington Department of Natural Resources (1995) and Beak Consultants (1994, 1995). However, marbled murrelets were found on U.S. Forest Service land in 1999 during surveys conducted for a proposed land exchange. Based on existing information, there would not be any impact to this species from any of the alternatives. Site-specific analyses for each of the 50 proposed restoration projects would occur to ensure that no suitable nesting habitat lies within the project site.

For the northern spotted owl, seven of the proposed 50 projects fall within the 1.8-mile home range radius of spotted owl activity centers in the upper basin. Prior to commencement of these projects, the USFWS would be consulted regarding the proposed activities (timing and duration of construction) and any vegetation removal. The projects under the restoration plan are not likely to adversely affect spotted owls.

No spotted frogs have been observed in the Green River Basin; sightings in Thurston County are the only confirmed observations in 23 years in western Washington lowlands. There would likely be no direct effect of the projects on spotted frogs since the species is unlikely to occur in the basin.

4.10 Air Quality

Because there can be no quantitative evaluation of air impacts at the programmatic level, this section qualitatively discusses potential air quality impacts that could result from implementation of all of the restoration alternatives. Evaluation of project-specific air quality impacts would occur as a part of the NEPA/SEPA environmental review for individual restoration projects.

Because of the nature of the restoration activities likely to be implemented (e.g., stream channel modifications, levee setbacks, construction of artificial spawning channels, etc.), any air quality impacts would be associated with ground clearing activities and emissions from construction equipment. Such activities would be short-term (lasting only for the duration of the clearing and/or construction period) and would have a minimal impact on overall air quality in the region. To the extent that restoration activities result in increased vegetation, air quality over the long term would improve.

Land clearing (if required) for individual projects would result in the generation of fugitive dust emissions. Clearing activities include grubbing and earth moving, dredging, soil and sediment storage and transport, digging, grading, burning and planting. These activities would generate fugitive dust in amounts roughly correlating to the amount of material being moved and the duration of the clearing activity. Once construction activities were completed there would be no further fugitive dust emissions.

Fugitive dust emissions are expected to contribute an insignificant burden to the ambient air contaminant load and are not expected to exceed ambient air quality standards.

4.10.1 Air Quality Conformity Analysis

Under the Federal General Conformity Rule (40 CFR Parts 6, 51, and 93), direct and indirect air pollutant emissions that are generated within a nonattainment area or a maintenance area as a result of a federal action are regulated. Because the activities proposed by this project would constitute actions by one or more federal agencies, the activities would need to be considered for conformity with the State Implementation Plan (SIP). Portions of the project area lie within the nonattainment area for particulate matter (PM10) and maintenance area for carbon monoxide (CO) and ozone. As precursors to ozone, volatile organic compounds (VOCs) and nitrous oxides (NOx) are the regulated air pollutants that are subject to conformity within an ozone maintenance area.

Typical activities anticipated for restoration projects whose emissions (including carbon monoxide, particulates, volatile organic compounds, and nitrous oxides) would need to be included in the conformity analysis include, but are not limited to, those mentioned above. Activities would need to be specified according to location (inside or outside the nonattainment/maintenance area boundaries), type of equipment, and hours of operation. From these data, total emission estimates for each of the criteria pollutants (CO, PM10, VOCs, and NOx) can be estimated using EPA emission equations and models. Emission estimates are then compared to the conformity thresholds in Table 4-1.

If none of the applicable threshold values are exceeded, the projects are not subject to further conformity analysis under the SIP. If one or more of the threshold values is exceeded, measures to offset, mitigate, or otherwise reduce the emissions must be identified so that there is no net increase in the emissions of that particular pollutant.

Table 4-1. Nonattainment (Maintenance) Area Conformity Threshold Values

Pollutant	Type of Area	Emission Threshold (tons per year)
Ozone (VOCs and NO_x)	maintenance (inside ozone transport region)	50
	maintenance (outside ozone transport region)	100
Carbon Monoxide	maintenance	100
PM10	Moderate NAA	100
	serious NAA	70
	maintenance	100
SO_2 and NO_2	NAA and maintenance	100
Lead	NAA and maintenance	25

NAA – nonattainment area

The types of projects anticipated are far smaller than highway construction, port dredging, or commercial development projects. The sites where restoration construction projects are anticipated to occur are limited in size and the construction duration would generally be limited. In general, approximately one to five projects per year might be implemented under this program, not all of which would involve physical construction activities (e.g., land clearing, construction vehicles, etc.). As a result, it is unlikely that annual emissions for these projects will exceed the applicable annual thresholds. Nonetheless, as the projects are specified and scheduled, the annual emission estimate calculations must be performed to verify that the conformity thresholds are not exceeded.

4.11 Noise

Noise impacts specific to individual restoration projects will be defined during subsequent NEPA/SEPA environmental review for each of the projects. Project-specific environmental reviews would include an impact analysis that would compare predicted noise levels resulting from the project with the applicable noise levels and an indication of conformity with any applicable noise standards. Noise abatement measures would be considered based on the degree of impact associated with the individual project.

Construction activities, such as the creation or enhancement of habitat, installation of LWD and gravel and cobble, or construction of weirs, would generate short-term noise impacts due to the use of heavy equipment. Noise impacts would depend on the nature and location of the activity, the surrounding land uses, the number of sensitive noise receptors (e.g., residences) in the immediate vicinity of the project, and the types of equipment used. For example, a construction activity occurring along the Duwamish River in the industrial part of Seattle would have less

noise impact than the same activity in the upper basin because of the higher ambient noise levels in the Seattle metropolitan area.

Overall, the long-term noise impacts of projects under any of the alternatives are expected to be far less than other types of developments such as new roads, or other heavy industrial or commercial use activities.

During construction, there would be a temporary increase in sound levels due to the use of heavy equipment and the hauling of materials. The types of equipment used for these types of projects will typically generate noise levels between 80 and 90 dBA at a distance of 50 feet while the equipment is operating (EPA 1971, Toth 1979, Gharabegian et al. 1985). The sound level impacts resulting from construction would be short-term and temporary. Depending on location (e.g., industrial locations), background noise from existing sources and noise from other nearby commercial and industrial activities would mask construction noise. Construction noise levels would not be continuous and would generally be restricted to daytime, weekday hours.

In addition, sounds created from construction activity at temporary construction sites are exempt from the King County's noise ordinance except between the hours of 10 p.m. and 7 a.m. when construction noise levels would be especially bothersome at residential receivers.

4.12 Traffic and Transportation

Implementation of any of the project alternatives and subsequent construction would require the movement of equipment and materials along existing roadways within the Green River Basin. The impact on roadways and traffic will depend on the location and type of the restoration activities.

Access to proposed restoration sites will vary from site to site. Construction of temporary access roads, of variable length, may be required in some cases.

Under Alternatives 2B and 3B, artificial habitat features may be constructed on existing infrastructure such as roadway riprap and bridge and culvert crossings. This action could improve the function of those features as fish habitat.

4.13 Land and Shoreline Use

Because the Green River Basin contains a wide variety of land use types, this section qualitatively discusses potential land use impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific land use impacts would occur as a part of the NEPA/SEPA environmental review for each restoration project.

Under all alternatives, general land use patterns and aesthetic qualities should not be adversely affected under any alternative. Land ownership may be affected if direct land purchase is required; however this should not affect the overall balance of ownership patterns within the basin. Land management practices would not be affected since the pertinent local plans and ordinances, as well as state planning regulations, encourage the preservation and restoration of the basin’s vital natural resources.

The nature and scope of the restoration activities likely to be implemented (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide land use impacts from occurring. Short- and long-term impacts on immediately adjacent land uses from construction activities (lasting only the duration of the construction period) will be analyzed and mitigated under the project-specific environmental review process.

Public access to natural resources could benefit from the individual restoration projects, if the project(s) include trails, viewpoints, and interpretive signs. In such cases, environmental impacts might result if roadways and parking must be provided for access and viewing areas. The specific project design process should balance the goals of public access and habitat restoration.

Descriptions of current development trends, and the federal, state, Tribal and local government plans and policies, have been reflected in the basin's comprehensive development plans, including land use, transportation, public facilities, housing, and community services. Restoration site planning, construction, and maintenance would not significantly impact development planning within the basin.

Site-specific documentation will assess the potential to induce growth and consistency with applicable comprehensive development plans adopted for the area. Land use types will affect the potential for the success of any restoration project more than restoration activity will impact land use patterns. Land for restoration must not only be available, but it must also be compatible with existing plans and federal, Tribal, state, and local regulatory constraints on the use of land for restoration purposes.

4.14 Recreation

This section qualitatively discusses potential recreation impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific recreation impacts would occur as a part of the subsequent NEPA/SEPA environmental review for individual restoration projects. The environmental review of individual restoration projects should include a siting evaluation with regard to recreational uses in the vicinity and potential impacts of the project during and after construction. During construction, there could be temporary and localized increases in noise, dust, and construction-related traffic, including detours. These conditions may temporarily decrease the quality of the recreational experience at the recreational facilities near the active construction areas. Construction impacts on recreational facilities or areas in the vicinity would be minor, short-term, and evaluated during the environmental review of each specific restoration project.

The nature and scope of the restoration activities likely to be implemented (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide recreational impacts from occurring. Public access to natural resources could benefit under each of the alternatives, if restoration projects included trails, viewpoints, and interpretive signs. In such cases, given that roadways and parking must be provided for viewing areas, environmental impacts might result. The specific project design process should balance the goals of public access and habitat restoration.

The greatest potential for recreational impact exists with the placement of LWD within the river and tributaries (Alternatives 1, 2A, 2C, 3A, 3C). LWD and recreational boating was an issue raised during scoping. The popularity of boating and floating recreation within the basin necessitates that individual restoration project environmental reviews address the placement and visibility of LWD in-river to reduce the potential for injury to recreationalists or damage to their equipment. Guidance for such placement would be derived from the LWD and recreation study conducted by King County.

It is anticipated that the recreational experience would improve over time as natural conditions on the river improve from revegetation, levee setbacks, and other habitat improvements.

4.15 Visual Quality and Aesthetic Resources

Because the Green River Basin contains a wide variety of natural, rural, and urban land use types, this section qualitatively discusses potential impacts to the basin's visual quality and aesthetic resources that could result from implementation of the restoration alternatives. Evaluation of project-specific impacts would occur as a part of the NEPA/SEPA environmental review for individual restoration projects.

Aesthetic qualities should not be adversely affected under any of the alternatives. Minor changes in localized views may result; however, this should not affect the overall aesthetics within the basin. Primary viewers in the vicinity of individual restoration projects, and the most sensitive to changes in the visual environment, would include residents and recreationalists. Although those viewers in the vicinity of any of the individual restoration projects may view the visual changes positively, other residents may view the changes negatively.

Visibility of the projects will depend on siting. Those projects located within the more developed areas of the basin would be more visible to a large percentage of the population, and would therefore have a greater potential to create localized, minor impacts on visual quality and aesthetic resources. Construction activities and equipment would generally be visible in the immediate vicinity of urban developments and recreational facilities/areas. From greater distances, soil disturbances and road cuts would contrast with areas that remain vegetated in the less developed portions of the basin (e.g., the middle basin and the upper basin).

In the long term, aesthetic quality along portions of the river would improve with a more natural appearance through the revegetation, levee setbacks, and implementation of side channel, culvert replacement, and other restoration improvements.

4.16 Socioeconomics

4.16.1 Environmental Justice

Because the Green River Basin is a socioeconomically diverse region and no quantitative evaluation of impacts could occur at the programmatic level, this section qualitatively discusses potential socioeconomic impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific socioeconomic impacts would occur as a part of the environmental review for individual restoration projects.

The nature and scope of the restoration activities likely to be implemented under all alternatives (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide socioeconomic impacts from occurring. Short- and long-term impacts from construction activities (lasting only the duration of the construction period) will be analyzed and mitigated under the project-specific environmental review process.

Restoration work in the basin should not have significant adverse impacts upon the area's neighborhoods or community cohesion for the following reasons:

- No splitting of neighborhoods would occur.
- No isolation of any ethnic group or portion of any ethnic group would occur.
- No new developments would result, other than those that would foster public access and awareness of the communities' natural resources.
- Property values should not be decreased.
- There should be no separation of residents from community facilities.

Consideration of particular social groups in the immediate vicinity of any potential restoration site will be identified during the project-specific environmental review process.

Changes in travel patterns (e.g., vehicular, bicycle, and pedestrian), including cross street terminations, will reflect the views of the city and county. Impacts on schools (e.g., use of the restoration site for educational purposes), recreational areas, fire protection, etc. will be discussed on a project-specific basis.

Regional economic impacts, such as the effects of any alternative or project on the spatial distribution of development, will be insignificant. Individual restoration projects should not lead to commercial development. The project-specific environmental assessments should provide information on the effect of the pending action on:

- Established business districts.
- The economic health of the business district that might be adversely impacted
- The willingness and desire of the public and private sectors to cooperatively strengthen development and revitalization opportunities in business districts

Federal policy mandates that it is necessary for an EIS to address displacement impacts in the form of a complete relocation plan or summary to adequately explain the relocation situation along with a resolution of anticipated or known problems. Given the nature and scope of the individual restoration projects, there are no anticipated relocation issues.

The impacts to employment in the region would be minor, though of benefit. The county would benefit from the increased short- and long-term employment opportunities and income. There would be zero to a negligible influx of out-of-area construction workers. Local restaurants and

other service providers and retailers in the communities where individual restoration projects are located would experience a negligible increase in business during construction.

4.17 Public Services and Utilities

This section qualitatively discusses potential impacts to public services and utilities that could result from implementation of the restoration alternatives. Evaluation of project-specific recreation impacts would occur as a part of the NEPA/SEPA environmental review for individual restoration projects.

The nature and scope of the restoration activities likely to be implemented (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide impacts to public services and utilities. Specific short-term impacts from construction activities (lasting only the duration of the construction period) should be minor and localized, and will be analyzed and mitigated under the project-specific environmental review process. Potential short- and long-term impacts could include:

- Any unauthorized visitors to the restoration sites during or after construction would create the potential for increased demand for police services.
- Depending on the individual restoration projects, construction activities or equipment would temporarily increase the potential for fires on the project sites, especially during dry weather.
- Careless smoking could also temporarily increase the potential for fires in the area.
- The relatively high-risk nature of heavy construction may increase the likelihood of medical service being required at the individual project sites.

4.18 Cultural and Historic Resources

A quantitative analysis of impacts to cultural and historic resources cannot occur on a programmatic level. Therefore, this section qualitatively discusses potential impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific impacts would occur as part of the environmental review for individual restoration projects.

The basin contains numerous recorded archaeological, historical, and traditional Native American properties. Many if not most of the archaeological sites and traditional Native American locations are closely associated with the Green River and its primary tributaries. The potential for the discovery of more archaeological sites is high given the Holocene geological and modern history of the middle and lower basin. Additionally, large areas within the basin have never been subjected to systematic surface or subsurface investigation.

Under all alternatives, short-term impacts to cultural resources resulting from the proposed restoration activities could occur during construction, from movement and use of construction equipment at the restoration sites. The level of impact would vary depending on factors such as the extent of previous disturbance, the age of the affected sediments, and the action planned.

Long-term impacts to cultural resources would be associated with the ongoing functioning of the restoration activities. The majority of the proposed restoration activities are designed to modify stream morphology as described in Section 4.4. Changes in channel position and morphology, either intended or as an unexpected consequence of habitat improvements, have the potential to affect sub-surface archaeological material, possibly historical structures or buildings, or important characteristics of traditional cultural properties.

As specific projects are developed, research and field investigation will be undertaken in consultation with the Washington State Office of Archaeology and Historic Preservation, the Advisory Council on Historic Preservation, and concerned Tribes and local governments to gather information necessary for compliance with Section 106 of the National Historic Preservation Act (NHPA) (36 CFR 800) and other applicable laws, regulations, and orders. The general procedures will include efforts to identify historic properties that may be affected by the undertaking; the gathering of sufficient information to evaluate the eligibility of properties found for the National Register; and consultation among agencies and concerned parties to avoid or mitigate adverse effects to the significant properties (see Memorandum of Agreement in Appendix E). If the properties are of value only for their research potential, and the State Historic Preservation Office (SHPO) approves data recovery as mitigation, then a determination of "no adverse effect" can be achieved. Mitigation for traditional cultural properties or properties judged significant for reasons other than research potential may require measures other than data recovery. In addition, there is concern about discovery of archaeological material or human remains while construction is in progress or as a later consequence of the new habitat development.

The Memorandum of Agreement (MOA) in Appendix E sets forth the means by which the Corps will comply with Section 106 of the NHPA and other statutory requirements. The MOA is appropriate for projects when the effects on historic properties cannot be fully determined prior to approval and when similar kinds of actions are repeated.

4.19 **Mitigation Measures**

Mitigation measures are designed to eliminate or reduce the magnitude of adverse impacts on the environment associated with the construction and implementation of proposed actions. The objective of restoration activities associated with all alternatives is to improve habitat conditions for fish and wildlife resources in the basin. As a result, the need for mitigation measures to minimize impacts relates primarily to the short-term impacts of construction. The following mitigation measures will be implemented for the proposed project:

- Procedures and Best Management Practices (BMPs) will be developed for flagging sensitive areas (e.g., wetlands, sensitive plants, cultural resources, etc.) and utilities off-limits to construction, operation of heavy equipment at restoration sites to minimize impacts of soil compaction, stream crossings, construction access roads and staging areas, stockpiling of soil and construction materials, sanitation, and excavation, and maintenance of equipment (i.e., refueling, etc.).

- As a part of the project-specific evaluation process, site-specific surveys and environmental analyses will be conducted to locate sensitive wildlife species.

- Monitoring will be performed following project completion to ensure that restoration activities implemented at individual sites do not create long-term unintended consequences to fish, wildlife, and plant species, or their critical habitats, or adversely affect stream morphology or stream banks in the vicinity of the projects, or create unintended consequences for cultural and historic resources in the vicinity of the projects

- Mitigation measures for the cultural resources would include conducting cultural resources studies as early as possible in project design to avoid late discovery of cultural or historical properties that could delay implementation of a project, and to implement the stipulations set forth in the draft MOA (Appendix E).

- Guidance developed by the USFWS (unpub.) and WDFW (1998) will be utilized for the design and construction of restoration features.

- The following BMPs will be utilized for air quality: (1) Water all excavated or graded areas, (2) minimize the total construction area disturbed by clearing, earth moving, or excavation, (3) sweep paved streets adjacent to the project site at least once per day to remove silt accumulated from construction activities, and (4) maintain all construction vehicle internal combustion engines according to manufacturer specifications.

- The following BMPs will be utilized for noise: (1) Restrict construction activities within 1,000 feet of residences to daytime hours, and do not perform construction within 1,000 feet of an occupied dwelling on legal holidays, or between 10 p.m. and 7 a.m. on other days; (2) use noise control devices no less effective than those provided on the original equipment; and (3) place stationary noise-generating equipment as far away from existing businesses and buildings as is reasonably possible.

- A transportation plan will be developed for proposed restoration sites. The plan will include access considerations, scheduling, traffic control and specific transportation and traffic measures required by permits.

- All regulatory permits, official project authorizations, and compliance with federal, state, and local regulations and ordinances (e.g., National Environmental Policy Act, National Historic Preservation Act, Level I Contaminants Survey, etc.) will be secured before project implementation.

- For projects that include placing LWD in the mainstem channel, coordination with recreational boat clubs will occur by posting LWD locations on a Web page for recreational boaters.

- A fire and emergency response plan will be developed to include communications, locations of water truck and/or chemical fire suppression materials

4.20 Cumulative Impacts of the Alternatives

Cumulative impacts can result from "individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)". This section examines two levels of cumulative effects that may result from implementing the restoration program: (1) impact of all

restoration activities included in this action considered together; and (2) impacts of all future restoration activities included in this action considered collectively with other past, present and future activities within the Green/Duwamish River Basin.

4.20.1 Cumulative Impact of All Restoration Activities included in this Action

The three alternatives and three sub-alternatives analyzed in this EIS establish a standard approach to restoration activities in the Green/Duwamish River Basin. Under this action, a number of restoration activities would be implemented in the Green/Duwamish River Basin over the next decade.

Individual projects would range in size from fractions of an acre to tens of acres. Relatively minor impacts that might occur at individual restoration sites could occur over a relatively large area when all individual projects are considered together.

However, when examined within the broad geographic extent of the project area, adverse impacts of each project would be localized and relatively minor. Overall, restoration activities throughout the Green/Duwamish River Basin would provide a net benefit to water quality, fish, and fish habitat, and other natural resources such as vegetation and wildlife. Other impacts, as described in this section, would affect only a small portion of lands available for such uses within the Green/Duwamish River Basin.

4.20.2 Cumulative Impacts of All Future Watershed Management Projects Considered Together with Past, Present, and Future Human Actions in the Green/Duwamish River Basin

Impacts from implementing restoration projects throughout the Green/Duwamish River Basin would add to past, present, and future impacts occurring from other human activities in the region. Development, industry, navigation, and water control projects have resulted in long-term degraded conditions throughout most of the basin. Negative effects of restoration projects are temporary and associated only with project implementation. Negative effects are compensated by overall improvements in watershed condition, and, ultimately, increases in fish and wildlife habitats and populations.

The proposed restoration program would have beneficial cumulative effects with other habitat conservation enhancement projects, and would incrementally offset adverse impacts on habitat and related natural resources from past, present, and future development projects. Other ongoing and proposed programs include:

- HHD Continued Operation & Maintenance and the Additional Water Storage Project,
- Second Diversion Water Right and Tacoma Public Utilities/Muckleshoot Indian Tribal Agreement;
- King County Salmon Recovery efforts;
- federal Section 4(d) rules;

- King County Wastewater Treatment Plant Habitat Conservation Plan (HCP);
- Plum Creek HCP; and
- Tacoma Water HCP.

When considered in combination with the aforementioned programs, the proposed Green/Duwamish restoration plan would result in improved riverine habitats over the long term that will benefit the variety of fish and wildlife species in the basin described in this EIS. Several of the aforementioned programs would not be implemented for several years, and the full restoration benefits of all these actions may not be realized for 10 to 20 years. However, the implementation of individual projects each year will assist in increasing and improving fish and wildlife habitat throughout the basin. These restoration efforts will provide important elements of the life requirements for threatened and endangered species as well as other species.

Restoration projects are designed to restore or enhance lost or degraded habitat functions, to reduce the fragmentation of habitat areas, and to restore ecological functions at individual sites within the Green River Basin that cumulatively would provide a significant benefit to the resource.

Coordinated design, implementation of mitigation measures identified earlier, and monitoring during and after construction would make cumulative short-term (construction) impacts associated with implementing the restoration program insignificant.

Other habitat restoration or environmental remediation projects, land development or redevelopment activities, and local governmental plans or policies would also be subject to the same federal and state land planning and management regulations. Additionally, the Section 4(d) rules for chinook salmon (and bull trout at some yet-to-be-defined date) will result in guidance regarding a number of land use activities affecting the Green/Duwamish River including habitat restoration under watershed plans, urban development (including stormwater), forest management practices and Tribal plans. Modifications to local ordinances, policies, and plans to meet ESA requirements will further result in cumulative benefits to the Green River resources.

4.21 Conclusions

Under No Action (Alternative 1), restoration projects would be limited to a small number of individual projects rather than the proposed program that could result in a more significant cumulative contribution to resource restoration. In contrast, both of the action alternatives (Alternatives 2 and 3) would consolidate restoration efforts in the basin under one "umbrella" plan, resulting in large-scale habitat improvements throughout the basin.

In general, Alternative 2 would provide ecological benefits to a larger area of the basin and to more species than Alternative 3. Alternative 2 would include restoration efforts throughout the basin to benefit multiple fish, riparian, and river-dependent species, whereas Alternative 3 would focus on chinook salmon habitat in the mainstem river and major tributaries only.

Alternative 2C would incorporate the full range of methods for improving environmental conditions in the basin (both ecosystem and engineered methods). Therefore this alternative has the greatest potential for resulting in benefits to basin habitats.

Overall, each of the action alternatives may result in temporary, relatively minor construction-related impacts as projects are implemented. Use of the mitigation measures described in Section 4.19 would minimize impacts during and after construction.